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Studies on Correlation for Growth, Yield and Quality Characters in Cherry Tomato [*Solanum lycopersicum* (L.) var. *cerasiforme* Mill.]

E. Venkadeswaran[1*], P. Irene Vethamoni[1], T. Arumugam[2], N. Manivannan[3] and S. Harish[4]
[1]Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore - 641 003, India.
[2]Horticultural College and Research Institute, Periyakulam - 625 604, India.
[3]Centre for Plant Breeding and Genetics, Tamil Nadu Agricultural University, Coimbatore - 641 003, India.
[4]Agricultural College and Research Institute, Madurai - 625 104, India.

(Corresponding author: E. Venkadeswaran)*
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ABSTRACT: A filed experiment was conducted in the university orchard, Department of Vegetable Crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India. The 24 cherry tomato genotypes were evaluated to estimate the nature and magnitude of associations of different characters with fruit yield. The experiment was conducted using Randomized Block Design and replicated thrice. The correlation coefficients of the cherry tomato genotypes revealed that the yield hectare^{-1} showed positive and significant association at genotypic level with plant height at flowering, plant height at final harvest, number of primary branches plant^{-1} at flowering, days to first flowering, number of flowering clusters (truss) plant^{-1}, number of fruits cluster^{-1}, number of fruit cluster plant^{-1}, number of fruits plant^{-1}, fruit length, number of locules fruit^{-1}, fruit weight, number of seeds fruit^{-1}, weight of 1000 seeds, yield plant^{-1}, shelf life of fruits, total sugars, titrable acidity and lycopene. The yield hectare^{-1} showed positive and significant association at phenotypic level with number of primary branches plant^{-1} at final harvest, number of flowers cluster^{-1}, fruit width, weight of seeds fruit^{-1}, fruit firmness, total soluble solids and total carotenoids. Hence, these traits may lead to the development of high yielding genotypes of cherry tomato.

Key words: *Cerasiforme*, cherry tomato, correlation, *Lycopersicum*, quality, yield.

INTRODUCTION

Most of the rural population is vegetarian and greatly depend fruits and vegetables to fulfill the daily need of carbohydrate, proteins, vitamins and minerals (Shukla, 2017). The vegetables and fruits played a crucial role in the human diet being considered as protective foods (Bharathi, 2021).Vegetables are the important component of the daily diet (Kirtane, 2018). Tomato [*Solanum lycopersicum* (L.)] is the second most cultivated vegetable crop in the world, after potato (Ojo and Umar, 2013). Cherry tomato [*Solanum lycopersicum* (L.) var. *cerasiforme* Mill.] is a wild ancestor of tomato rich in antioxidants such as lycopene, ascorbic acid and phenolics. It contains high concentrations of sugars and acids, contributing to its unique tomato flavour. The large variety of colours, flavors, vitamins and mineral salts that comprise the menu of vegetables attests to their importance in the daily diet (Simarelli, 2001). There is good scope for cultivation of cherry tomato due to reasonable and constant market price. Cherry tomatoes, one of the promising wild types of *Solanum*, in breeding programs offers great potential because of their valuable characteristics in terms of genetic diversity for selection of parental material and their broad geographic range (Medina and Lobo, 2001). They are source of germplasm for providing disease resistance and adaptability to cool and hot seasons. Therefore, potential value of cherry tomatoes has to be improved by evaluating the cultivated species for its desirable characters under various agro climatic regions (Prema *et al.*, 2011). To incorporate desirable yield and quality traits in a hybrid/variety, there is a need to understand the inter-relationships between yield and yield contributing traits, direct and indirect effect of the characters (Ara *et al.*, 2009). As, yield is the resultant of combined effect of several component characters and environment, understanding the interaction of characters among themselves and with environment has been of great use in the plant breeding. A crop breeding programme, aimed at increasing the plant productivity requires consideration not only of yield but also of its components that have a direct or indirect bearing on yield, the necessity of correlation coefficient to describe the degree of association between independent and dependent variables. This study will help the breeder to know the degree of association between traits, which can be used for crop improvement through selection of component traits. Character association studies are of great significance in the process of selection by which simultaneous improvement of more than one trait is possible. It is obvious that improvement of one trait results in the simultaneous improvement of all positively associated component traits (Kalloo, 1988). There is only one research work carried out in cherry tomato at Tamil Nadu Agricultural University, Coimbatore. Hence, this study has been proposed to make advantage of the suitable cherry tomato genotype for development variety or hybrids.

MATERIAL AND METHODS

The experiment was conducted in the university orchard, Department of Vegetable crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu. Twenty four cherry tomato genotypes were collected from various research institutes across the country viz., Indian Institute of Horticultural Research, Bengaluru (IIHR 2753, IIHR 2754, IIHR 2871, IIHR 2873 and IIHR 2876), Indian Agricultural Research Institute, New Delhi (Pusa Cherry Tomato 1), Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (Pant Cherry Tomato 1) and Tamil Nadu Agricultural University, Coimbatore (ATL-01-19, HAT 20, LE 13, LE 87, LE 89, LE 315, LE 338, LE 598, LE 887, LE 1223, PAV 2373, VGT 89, VGT 90, VGT 95, VR 35, VRCT 17 and VRCT 155). The experiment was conducted using Randomized Block Design and replicated thrice. All other recommended cultural practices for the crop were followed. Five randomly selected competitive plants from each row in each replication were tagged for the purpose of recording of the observations on different characters. Genotypic correlation coefficients were worked out among different traits using *per se* values. Correlations analysis was carried out as suggested by (Al-Jibouri *et al*., 1958).

RESULT AND DISCUSSION

The genotypic and phenotypic correlation coefficients between yield hectare^{-1} and interrelationship among the traits were computed. It was observed that in genotypic correlation coefficients were of higher magnitude than the phenotypic correlation coefficients (Table 1). Based on genotypic and phenotypic correlation coefficients between yield hectare^{-1} and interrelationship among the traits it was observed that in genotypic correlation coefficients were of higher magnitude than the phenotypic correlation coefficients. The higher level of genotypic correlation is due to its masking effect on the influence of environment in the total expression of the traits by the genotypes.

The present investigation on twenty four cherry tomato germplasm revealed that the yield hectare^{-1} showed positive and significant association at genotypic level with plant height at flowering (2.386), plant height at final harvest (1.317), number of primary branches plant^{-1} at flowering (1.564), days to first flowering (0.971), number of flower clusters (truss) plant^{-1} (0.881), number of fruits cluster^{-1} (0.483), Number of fruit clusters plant^{-1} (1.429), number of fruits plant^{-1} (1.262), fruit length (1.331), number of locules fruit^{-1} (1.857), fruit weight (1.124), number of seeds fruit^{-1} (1.377), weight of 1000 seeds (1.274), yield plant^{-1} (1.231), shelf life of fruits (1.572), total sugars (0.761), titrable acidity (1.288) andlycopene (1.445).

The yield hectare^{-1} showed negative and significant association at genotypic level with number of primary branches plant^{-1} at final harvest (-0.582), number of flowers cluster^{-1} (-0.660), fruit width (-0.920), weight of seeds fruit^{-1} (-0.726), pericarp thickness (-0.417), total soluble solids (-1.100) and total carotenoids (-0.578). The present investigation on twenty four cherry tomato germplasm revealed that the yield hectare^{-1} showed positive and significant association at phenotypic level with number of primary branches plant^{-1} at final harvest (0.784), number of flowers cluster^{-1} (0.842), fruit width (0.890), weight of seeds fruit^{-1} (0.336), fruit firmness (0.906), total soluble solids (0.893) and total carotenoids (0.790). The yield hectare^{-1} showed negative and significant association at phenotypic level fruit length (-0.456) and fruit weight (-0.481).

A. Growth and yield contributing characters

The interrelationship genotypic level of various yield components showed that the plant height at flowering exhibited positive and significant relationship with number of primary branches plant^{-1} at final harvest (1.822), number of flowers cluster^{-1} (2.624), number of fruits cluster^{-1} (1.074), fruit length (0.697), fruit width (1.937), number of locules fruit^{-1} (0.371), number of seeds fruit^{-1} (0.950), weight of seeds fruit^{-1} (1.392), fruit firmness (1.540), pericarp thickness (1.110), total soluble solids (1.368), total sugars (0.989), total carotenoids (1.827) and yield hectare^{-1} (2.386). The negative and significant association at genotypic level was registered with plant height at final harvest (-1.214), days to first flowering (-1.179), number of flower clusters (truss) plant^{-1} (-0.605), Number of fruit clusters plant^{-1} (-0.490), number of fruits plant^{-1} (-0.598), fruit weight (-0.357), yield plant^{-1} (-0.880), shelf life of fruits (-0.796), ascorbic acid (-1.001), titrable acidity (-1.178) and lycopene (-0.442).

Table 1: Genotypic and phenotypic correlation coefficients among growth, yield and quality traits in cherry tomato.

Traits	G&P	PHFL	PHFH	NPBF	NPBH	DFFL	NFLC	NFLP	NFTC	NFCP	NFTP	FTLT	FTWD	NLOF	FTWT
PHFL	G	1.000	-1.214**	-0.100	1.822**	-1.179**	2.624**	-0.605**	1.074**	-0.490**	-0.598**	0.697**	1.937**	0.371*	-0.357*
	P	1.000	0.862**	0.046	-0.200	0.868**	-0.237	0.768**	-0.097	0.127	0.795**	0.014	-0.317	0.029	0.056
PHFH	G		1.000	-0.607**	1.153**	-0.915**	1.664**	-0.873**	0.922**	-0.667**	-0.742**	0.399*	1.239**	-0.138	-0.334*
	P		1.000	0.122	-0.303	0.867**	-0.211	0.667**	-0.368*	0.210	0.747**	-0.263	-0.321	0.005	0.046
NPBF	G			1.000	1.224**	-0.409*	1.057**	0.526**	0.457**	-0.951**	0.609**	0.116	0.721**	-0.686**	-0.928**
	P			1.000	-0.306	-0.154	-0.006	-0.267	-0.362*	0.866**	-0.232	0.081	-0.188	0.807**	0.798**
NPBH	G				1.000	0.964**	-0.863**	1.369**	-0.460**	0.903**	1.035**	0.270	-0.847**	0.693**	0.406*
	P				1.000	-0.173	0.769**	-0.245	0.202	-0.275	0.094	-0.065	0.869**	-0.023	-0.276
DFFL	G					1.000	1.203**	-0.976**	1.006**	-0.435**	-0.735**	0.539**	1.106**	0.056	-0.156
	P					1.000	-0.176	0.793**	-0.204	-0.080	0.747**	-0.240	-0.229	-0.236	-0.178
NFLC	G						1.000	1.594**	0.373*	0.759**	2.362**	0.900**	-0.972**	0.939**	0.442**
	P						1.000	-0.330*	-0.164	0.048	-0.014	-0.261	0.844**	0.167	-0.108
NFLP	G							1.000	1.287**	0.297	-0.842**	1.216**	1.058**	1.232**	0.511**
	P							1.000	-0.171	-0.315	0.763**	-0.252	-0.282	-0.474**	-0.434**
NFTC	G								1.000	0.118	1.288**	-1.091**	0.044	-0.404**	-0.329*
	P								1.000	-0.320	-0.156	0.777**	-0.072	-0.050	0.034
NFCP	G									1.000	0.227	-0.002	0.827**	-0.868**	-0.919**
	P									1.000	-0.208	0.163	-0.205	0.866**	0.862**
NFTP	G										1.000	1.120**	1.056**	1.061**	0.418**
	P										1.000	-0.319	0.059	-0.293	-0.358*
FTLT	G											1.000	0.695*	-0.368*	-0.592**
	P											1.000	-0.317	0.368*	0.474**
FTWD	G												1.000	0.683**	0.519**
	P												1.000	-0.011	-0.316
NLOF	G													1.000	-1.139**
	P													1.000	0.895**
FTWT	G														1.000
	P														1.000

***Significant at 5 per cent level** ****Significant at 1 per cent level**

PHFL	Plant height at flowering (cm)	NFTC	Number of fruits cluster^{-1}	NSDF	Number of seeds fruit^{-1}	SLFT	Shelf life of fruits (days)
PHFH	Plant height at final harvest (cm)	NFCP	Number of fruit clusters plant^{-1}	WSDF	Weight of seeds fruit^{-1} (g)	TTSS	Total soluble solids (°Brix)
NPBF	Number of primary branches plant^{-1} at flowering	NFTP	Number of fruits plant^{-1}	WTSD	Weight of 1000 seeds (g)	TTSG	Total sugars (mg 100 g^{-1})
NPBH	Number of primary branches plant^{-1} at final harvest	FTLT	Fruit length (cm)	YLDP	Yield plant^{-1} (g)	TTAC	Titrable acidity (per cent)
DFFL	Days to first flowering	FTWD	Fruit width (cm)	YLDH	Yield hectare^{-1} (tonnes)	LYCP	Lycopene (mg 100 g^{-1})
NFLC	Number of flowers cluster^{-1}	NLOF	Number of locules fruit^{-1}	FTFM	Fruit firmness (kg sq. cm^{-1})	TTCR	Total carotenoids (mg 100 g^{-1})
NFLP	Number of flower clusters (truss) plant-1	FTWT	Fruit weight (g)	PRTK	Pericarp thickness (mm)		

(continued)…..

Traits	G&P	NSDF	WSDF	WTSD	YLDP	FTFM	PRTK	SLFT	TTSS	TTSG	TTAC	LYCP	TTCR	YLDH
PHFL	G	0.950**	1.392**	-0.225	-0.880**	1.540**	1.110**	-0.796**	1.368**	0.989**	-1.178**	-0.442**	1.827**	2.386**
	P	0.193	-0.472**	-0.045	0.871**	-0.518**	-0.310**	0.372*	-0.344*	0.015	0.884**	0.060	-0.200	-0.234
PHFH	G	0.429**	0.479**	-0.373*	-0.932**	1.045**	0.110	-0.900**	0.896**	0.637**	-1.001**	-0.834**	1.190**	1.317**
	P	-0.120	-0.426**	0.056	0.827**	-0.454**	-0.355*	0.475**	-0.286	-0.317	0.990**	0.126	-0.307	-0.235
NPBF	G	1.358**	1.434**	-0.896**	-0.043	0.564**	2.100**	-0.856**	0.600**	0.568**	-0.614**	-1.002**	1.215**	1.564**
	P	-0.240	0.036	0.792**	-0.178	-0.211	-0.014	0.721**	-0.131	-0.206	0.101	0.895**	-0.308	-0.214
NPBH	G	0.140	0.428**	0.601**	1.314**	-0.658**	0.658**	1.207**	-0.829**	-0.169	1.152**	1.179**	-1.001**	-0.582**
	P	0.063	-0.051	-0.244	-0.158	0.688**	-0.276	-0.233	0.796**	0.141	-0.296	-0.305	0.995**	0.784**
DFFL	G	0.426**	0.330*	-0.057	-0.974**	0.861**	-0.021	-0.768**	0.734**	0.700**	-0.902**	-0.654**	0.986**	0.971**
	P	0.034	-0.467**	-0.239	0.881**	-0.363*	-0.362*	0.220	-0.214	-0.185	0.871**	-0.143	-0.172	-0.133
NFLC	G	1.029**	0.433**	0.524**	1.959**	-1.072**	0.815**	1.221**	-1.218**	0.235	1.667**	0.882**	-0.859**	-0.660**
	P	-0.250	0.070	0.016	-0.202	0.781**	-0.237	0.086	0.811**	-0.184	-0.214	0.041	0.786**	0.842**
NFLP	G	1.172**	-0.210	0.519**	-1.020**	0.616**	-0.393*	-0.048	0.633**	1.365**	-0.865**	0.388**	1.361**	0.881**
	P	0.076	-0.047	-0.479**	0.869**	-0.280	0.094	-0.049	-0.258	-0.160	0.691**	-0.285	-0.246	-0.060
NFTC	G	-1.147**	0.284	-0.367*	1.200**	0.252	0.414*	0.374*	0.161	-1.091**	0.962**	0.417*	-0.432**	0.483**
	P	0.815**	-0.240	-0.225	-0.229	-0.178	-0.035	-0.473**	-0.219	0.897**	-0.362*	-0.363*	0.211	-0.224
NFCP	G	0.775**	1.736**	-0.944**	-0.075	0.646**	1.933**	-0.936**	0.584**	0.276	-0.672**	-1.010**	0.883**	1.429**
	P	-0.194	-0.151	0.872**	-0.154	-0.315	-0.185	0.866**	-0.194	-0.156	0.186	0.890**	-0.282	-0.295
NFTP	G	1.151**	0.200	0.450**	-0.745**	0.819	0.111	-0.135	0.546**	1.098**	-0.751**	0.259	1.095**	1.262**
	P	-0.018	-0.260	-0.376*	0.848**	-0.108	-0.237	0.071	0.038	-0.194	0.775**	-0.241	0.091	0.150
FTLT	G	-0.873**	1.639**	-0.633**	0.884**	0.692**	1.556**	0.241	0.665**	-0.938**	0.450**	0.336*	0.252	1.331**
	P	0.815**	-0.244	0.225	-0.277	-0.439**	0.004	-0.032	-0.464**	0.895**	-0.268	0.108	-0.060	-0.456**
FTWD	G	0.904**	-0.401*	0.597**	1.452**	-0.984**	-0.066	1.042**	-1.026**	0.274	1.239**	0.679**	-0.842**	-0.920**
	P	-0.215	0.142	-0.194	-0.207	0.864**	-0.186	-0.158	0.922**	-0.156	-0.319	-0.190	0.874**	0.890**
NLOF	G	0.566**	2.433**	-1.086**	0.680**	0.744**	2.834**	-0.657**	0.703**	-0.162	-0.123	-0.751**	0.709**	1.857**
	P	0.026	-0.197	0.857**	-0.308	-0.197	-0.241	0.753**	-0.067	0.112	-0.019	0.843**	-0.025	-0.179
FTWT	G	0.148	1.448**	-0.963**	0.102	0.604**	1.785**	-0.812**	0.504**	-0.280	-0.332**	-0.926**	0.410*	1.124**
	P	0.096	-0.296	0.836**	-0.279	-0.449**	-0.225	0.675**	-0.320	0.184	0.026	0.835**	-0.280	-0.481**
NSDF	G	1.000	1.629**	0.117	0.815**	0.773**	2.313**	0.569**	0.861**	-0.946**	0.514**	1.558**	0.108	1.377**
	P	1.000	-0.323	-0.164	0.046	-0.366*	-0.055	-0.263	-0.366**	0.887**	-0.114	-0.236	0.077	-0.293
WSDF	G		1.000	1.253**	0.143	-0.939**	-1.003**	1.936**	-0.558**	0.969**	0.439**	2.048**	0.418**	-0.726**
	P		1.000	-0.153	-0.303	0.448**	0.830**	-0.235	0.201	-0.276	-0.427**	0.023	-0.055	0.336**
WTSD	G			1.000	0.169	0.563**	1.243**	-0.804**	0.706**	-0.281	-0.364**	-0.949**	0.586**	1.274**
	P			1.000	-0.325*	-0.285	-0.139	0.746**	-0.185	-0.079	0.032	0.801**	-0.249	-0.312
YLDP	G				1.000	0.928**	-0.220	-0.472**	0.846**	1.083**	-0.922**	-0.263	1.321**	1.231**
	P				1.000	-0.315	-0.201	0.151	-0.193	-0.206	0.862**	-0.188	-0.157	-0.044
FTFM	G					1.000	-0.665**	0.871**	-0.952**	0.368**	1.023**	0.585**	-0.652**	-1.148
	P					1.000	0.103	-0.300	0.904**	-0.283	-0.451**	-0.222	0.703**	0.906**
PRTK	G						1.000	1.780**	-0.158	1.139**	0.096	2.774**	0.661**	-0.417*
	P						1.000	-0.305	-0.149	-0.037	-0.352*	-0.040	-0.281	0.029
SLFT	G							1.000	0.804**	0.451**	-0.900**	-0.992**	1.210**	1.572**
	P							1.000	-0.148	-0.307	0.459**	0.837**	-0.239	-0.195
TTSS	G								1.000	0.353*	0.876**	0.543**	-0.818**	-1.100**
	P								1.000	-0.314	-0.283	-0.144	0.807**	0.893**
TTSG	G									1.000	0.711**	0.659**	-0.195	0.761**
	P									1.000	-0.314	-0.199	0.150	-0.291
TTAC	G										1.000	-0.832**	1.185**	1.288**
	P										1.000	0.108	-0.299	-0.224
LYCP	G											1.000	1.184	1.445**
	P											1.000	-0.309	-0.230
TTCR	G												1.000	-0.578**
	P												1.000	0.790**

The interrelationship phenotypic level of various yield components showed that the plant height at flowering exhibited positive and significant relationship with plant height at final harvest (0.862), days to first flowering (0.868), number of flower clusters (truss) plant^{-1} (0.768), number of fruits plant^{-1} (0.795), yield plant^{-1} (0.871), shelf life of fruits (0.372), total soluble solids (-0.344) and titrable acidity (0.884). The negative and significant association at phenotypic level was registered with weight of seeds fruit^{-1} (-0.472), fruit firmness (-0.518) and pericarp thickness (-0.310). Plant height at final harvest exhibited positive and significant relationship with number of primary branches plant^{-1} at final harvest (1.153), inter nodal length of mainstem (1.166), number of flowers cluster^{-1} (1.664), number of fruits cluster^{-1} (0.922), fruit length (0.399), fruit width (1.239), number of seeds fruit^{-1} (0.429), weight of seeds fruit^{-1} (0.479), fruit firmness (1.045), total soluble solids (0.896), total sugars (0.637), total carotenoids (1.190) and yield hectare^{-1} (1.317). The negative and significant association at genotypic level was registered with number of primary branches plant^{-1} at flowering (-0.607), days to first flowering (-0.915), number of flowering clusters (truss) plant^{-1} (-0.873), Number of fruit clusters plant^{-1} (-0.667), number of fruits plant^{-1} (-0.742), fruit weight (-0.334), weight of 1000 seeds (-0.373), yield plant^{-1} (-0.932), shelf life of fruits (-0.900), ascorbic acid (-1.222), titrable acidity (-1.001) and lycopene (-0.834). Similar results were also observed by Mohanty (2002), Manivannan *et al.*, (2005), Mayavel *et al.* (2005), Raut *et al.*, (2005), Dhankhar and Dhankar (2006), Kumar and Dudi (2011), Mahapatra *et al*., (2013), Sherpa *et al*., (2014) and Kumar *et al*., (2020).

Number of primary branches plant^{-1} at flowering was positively and significantly correlated with number of primary branches plant^{-1} at final harvest (1.224), number of flowers cluster^{-1} (1.057), number of flower clusters (truss) plant^{-1} (0.526), number of fruits cluster^{-1} (0.457), days from fruit set to fruit maturity (1.302), number of fruits plant^{-1} (0.609), fruit girth (0.826), fruit width (0.721), number of seeds fruit^{-1} (1.358), weight of seeds fruit^{-1} (1.434), fruit firmness (0.564), pericarp thickness (2.100), total soluble solids (0.600), total sugars (0.568), total carotenoids (1.215) and yield hectare^{-1} (1.564). The negative and significant association at genotypic level was registered with days to first flowering (-0.409), Number of fruit clusters plant^{-1} (-0.951), number of locules fruit^{-1} (-0.686), fruit weight (-0.928), weight of 1000 seeds (-0.896), shelf life of fruits (-0.856), titrable acidity (-0.614) and lycopene (-1.002). Plant height at final harvest exhibited positive and significant relationship with days to first flowering (0.867), number of flower clusters (truss) plant^{-1} (0.667), number of fruits plant^{-1} (0.747), yield plant^{-1} (0.827), shelf life of fruits (0.475) and titrable acidity (0.990). The negative and significant association at phenotypic level was registered with stem girth (-0.451), number of fruits cluster^{-1} (-0.368), weight of seeds fruit^{-1} (-0.426), fruit firmness (-0.454) and pericarp thickness (-0.355). Number of primary branches plant^{-1} at flowering was positively and significantly correlated with number of locules fruit^{-1} (0.807), fruit weight (0.798), weight of 1000 seeds (0.792), shelf life of fruits (0.721) and lycopene (0.895). The negative and significant association at phenotypic level was registered with number of fruits cluster^{-1} (-0.362) and yield hectare^{-1} (-0.214). Number of primary branches plant^{-1} at final harvest exhibited positive and significant relationship with days to first flowering (0.964), number of flower clusters (truss) plant^{-1} (1.369), Number of fruit clusters plant^{-1} (0.903), per cent fruit set (0.550), number of fruits plant^{-1} (1.035), number of loculesfruit^{-1} (0.693), fruit weight (0.406), weight of seeds fruit^{-1} (0.428), weight of 1000seeds (0.601), yield plant^{-1} (1.314), pericarp thickness (0.658), shelf life of fruits (1.207), titrable acidity (1.152) and lycopene (1.179). The negative and significant association at genotypic level was registered with number of flowers cluster^{-1} (-0.863), number of fruits cluster^{-1} (-0.460), fruit width (-0.847), fruit firmness (-0.658), total soluble solids (-0.829), total carotenoids (-1.001) and yield hectare^{-1} (-0.582). Number of primary branches plant^{-1} at final harvest exhibited positive and significant relationship with number of flowers cluster^{-1} (0.769), Number of fruit clusters plant^{-1} (0.866), fruit width (0.869), fruit firmness (0.688), total soluble solids (0.796), total carotenoids (0.995) and yield hectare^{-1} (0.784). The negative and significant association at phenotypic level was registered stem girth (-0.347), number of fruits cluster^{-1} (-0.362) and days from fruit set to fruit maturity (-0.455). Similar results were also observed by Mohanty (2002), Prashanth (2003), Manivannan *et al.* (2005), Mayavel *et al.* (2005), Mehta and Asati (2008), Ara *et al*. (2009), Regassa *et al.* (2012), Kumar and Dudi (2011), Mahapatra *et al*. (2013) and Kumar *et al*. (2020).

Days to first flowering exhibited positive and significant relationship with number of flowers cluster^{-1} (1.203), number of fruits cluster^{-1} (1.006), fruit length (0.539), fruit width (1.106), number of seeds fruit^{-1} (0.426), weight of seeds fruit^{-1} (0.330), fruit firmness (0.861), total soluble solids (0.734), total sugars (0.700), total carotenoids (0.986) and yield hectare^{-1} (0.971). The negative and significant association at genotypic level was registered with number of flower clusters (truss) plant^{-1} (-0.976), Number of fruit clusters plant^{-1} (-0.435), number of fruits plant^{-1} (-0.735), yield plant^{-1} (-0.974), shelf life of fruits (-0.768), titrable acidity (-0.902) and lycopene (-0.654). Days to first flowering exhibited positive and significant relationship with number of flower clusters (truss) plant^{-1} (0.793), number of fruits plant^{-1} (0.747), yield plant^{-1} (0.881) and titrable acidity (0.871). The negative and significant association at phenotypic level was registered with weight of seeds fruit^{-1} (-0.467), fruit firmness (-0.363) and pericarp thickness (-0.362). Similar results were also observed by Sherpa *et al*. (2014) and Kumar *et al*. (2020)

Number of flowers cluster^{-1} was positively and significantly correlated with number of flower clusters (truss) plant^{-1} (1.594), number of fruits cluster^{-1} (0.373), number of fruit clusters plant^{-1} (0.759), number of fruits plant^{-1} (2.362), fruit length (0.900), number of locules fruit^{-1} (0.939), fruit weight (0.442), number of seeds fruit^{-1} (1.029), weight of seeds fruit^{-1} (0.433), weight of 1000 seeds (0.524), yield plant^{-1} (1.959), pericarp thickness (0.815), shelf life of fruits (1.221), titrable acidity (1.667) and lycopene (0.882). The negative and significant association at genotypic level was registered with fruit width (-0.972), fruit firmness (-1.072), total soluble solids (-1.218), total carotenoids (-0.859) and yield hectare^{-1} (-0.660).Number of flowers cluster^{-1} was positively and significantly correlated with fruit width (0.844), fruit firmness (0.781), total soluble solids (0.811), total carotenoids (0.786) and yield hectare^{-1} (0.842). The negative and significant association at phenotypic level was registered with number of flower clusters (truss) plant^{-1} (-0.330) and per cent fruit set (-0.365).Number of fruits cluster^{-1} was positively and significantly correlated with fruit length (0.777), number of seeds fruit^{-1} (0.815) and total sugars (0.897). The negative and significant association at phenotypic level was registered with days from fruit set tofruit maturity (-0.337), shelf life of fruits (-0.473), titrable acidity (-0.362) and lycopene (-0.363). Similar results were also observed by Regassa *et al.,* (2012).Number of flower clusters (truss) plant^{-1} exhibited positive and significant relationship with number of fruits cluster^{-1} (1.287), fruit length (1.216), fruit width (1.058), number of locules fruit^{-1} (1.232), fruit weight (0.511), number of seeds fruit^{-1} (1.172), weight of 1000 seeds (0.519), fruit firmness (0.616), total soluble solids (0.633), total sugars (1.365), lycopene (0.388), total carotenoids (1.361) and yield hectare^{-1} (0.881). The negative and significant association at genotypic level was registered with number of fruits plant^{-1} (-0.842), yield plant^{-1} (-1.020), pericarp thickness (-0.393), as corbicacid (-0.597) and titrable acidity (-0.865).Number of flower clusters (truss) plant^{-1} exhibited positive and significant relationship with number of fruits plant^{-1} (0.763), yield plant^{-1} (0.869) and titrable acidity (0.691). The negative and significant association at phenotypic level was registered with number of locules fruit^{-1} (-0.474), fruit weight (-0.434) and weight of 1000 seeds (-0.479). Similar results were also observed by Mehta and Asati (2008), Kumar and Dudi (2011) and Mahapatra *et al*. (2013).

Number of fruits cluster^{-1} was positively and significantly correlated with number of fruits plant^{-1} (1.288), yield plant^{-1} (1.200), pericarp thickness (0.414), shelf life of fruits (0.374), titrable acidity (0.962), lycopene (0.417) and yield hectare^{-1} (0.483). The negative and significant association at genotypic level was registered with fruit length (-1.091), number of locules fruit^{-1} (-0.404), fruit weight (-0.329), number of seeds fruit^{-1} (-1.147), weight of 1000 seeds (-0.367), total sugars (-1.091) and total carotenoids (-0.432). These results were in agreement with findings of Ara *et al.* (2009), Kumar *et al.* (2013) and Sherpa *et al*. (2014). Number of fruit clusters plant^{-1} exhibited positive and significant relationship with fruit width (0.827), number of seeds fruit^{-1} (0.775), weight of seeds fruit^{-1} (1.736), fruit firmness (0.646), pericarp thickness (1.933), total soluble solids (0.584), total carotenoids (0.883)and yield hectare^{-1} (1.429). The negative and significant association at genotypic level was registered with number of locules fruit^{-1} (-0.868), fruit weight (-0.919), weight of 1000 seeds (-0.944), shelf life of fruits (-0.936), titrable acidity (-0.672) and lycopene (-1.010). Number of fruit clusters plant^{-1} exhibited positive and significant relationship with number of locules fruit^{-1} (0.866), fruit weight (0.862), weight of 1000 seeds (0.872), shelf life of fruits (0.866) and lycopene (0.890). There was no negative and significant association at phenotypic level was registered for this trait. These results were in agreement with findings of Ara *et al.* (2009)and Kumar *et al*. (2020).

Number of fruits plant^{-1} exhibited positive and significant relationship with fruit length (1.120), fruit width (1.056), number of locules fruit^{-1} (1.061), fruit weight (0.418), number of seeds fruit^{-1} (1.151), weight of 1000 seeds (0.450), total soluble solids (0.546), total sugars (1.098), total carotenoids (1.095) and yield hectare^{-1} (1.262). The negative and significant association at genotypic level was registered with yield plant^{-1} (-0.745) and titrable acidity (-0.751). Number of fruits plant^{-1} exhibited positive and significant relationship with yield plant^{-1} (0.848) and titrable acidity (0.775). The negative and significant association at phenotypic level was registered with fruit weight (-0.358) and weight of 1000 seeds (-0.376). Mohanty (2002), Mehta and Asati (2008), Indu Rani *et al*. (2010), Kumar and Dudi (2011), Regassa *et al.,* (2012), Tasisa *et al.*, (2012), Mahapatra *et al*., (2013) and Sherpa *et al*., (2014) also reported that the fruit number plant^{-1} was observed to be correlated with these traits.

Fruit length was positively and significantly correlated with fruit width (0.695), weight of seeds fruit^{-1} (1.639), yield plant^{-1} (0.884), fruit firmness (0.692), pericarp thickness (1.556), total soluble solids (0.665), titrable acidity (0.450), lycopene (0.336) and yield hectare^{-1} (1.331). The negative and significant association at genotypic level was registered with number of locules fruit^{-1} (-0.368), fruit weight (-0.592), number of seeds fruit^{-1} (-0.873), weight of 1000 seeds (-0.633) and total sugars (-0.938). Fruit length was positively and significantly correlated with number of locules fruit^{-1} (0.368), fruit weight (0.474), number of seeds fruit^{-1} (0.815) and total sugars (0.895). The negative and significant association at phenotypic level was registered with fruit firmness (-0.439), total soluble solids (-0.464) and yield hectare^{-1} (-0.456). Similar results were also observed by Manna and Paul (2012), Tasisa *et al.,* (2012), Chernet *et al.,* (2013), Kumar *et al*. (2013) and Mahapatra *et al*., (2013).Fruit width exhibited was positively and significantly correlated with number of locules fruit^{-1} (0.683), fruit weight (0.519), number of seeds fruit^{-1} (0.904), weight of 1000 seeds (0.597), yield plant^{-1} (1.452), shelf life of fruits (1.042), titrable acidity (1.239) and lycopene (0.679). The negative and significant association at genotypic level was registered with weight of seeds fruit^{-1} (-0.401), fruit firmness (-0.984), total soluble solids (-1.026), total carotenoids (-0.842) and yield hectare^{-1} (-0.920). Fruit width exhibited was positively and significantly correlated withfruit firmness (0.864), total soluble solids (0.922), total carotenoids (0.874) and yield hectare^{-1} (0.890). There was no negative and significant association at phenotypic level was registered for this trait. The result of the present investigation was in consonance with findings of Golani *et al*., (2007), Senugupta *et al.,* (2009), Chernet *et al.* (2013), Kumar *et al*., (2013), Manna and Paul (2012) and Mahapatra *et al*., (2013).

Number of locules fruit^{-1} exhibited positive and significant relationship with number of seeds fruit^{-1} (0.566), weight of seeds fruit^{-1} (2.433), yield plant^{-1} (0.680), fruit firmness (0.744), pericarp thickness (2.834), total soluble solids (0.703), ascorbic acid (0.374), total carotenoids (0.709) and yield hectare^{-1} (1.857). The negative and significant association at genotypic level was registered with fruit weight (-1.139), weight of 1000 seeds (-1.086), shelf life of fruits (-0.657) and lycopene (-0.751). Number of locules fruit^{-1} exhibited positive and significant relationship with fruit weight (0.895), weight of 1000 seeds (0.857), shelf life of fruits (0.753) and lycopene (0.843) while, the negative and significant association at phenotypic level was registered with yield hectare^{-1} (-0.179). Similar results were also reported by Golani *et al*., (2007), Kumar and Dudi (2011), Manna and Paul (2012), Mahapatra *et al*. (2013), Saini *et al*., (2013) and Sherpa *et al*., (2014). Fruit weight was positively and significantly correlated with weight of seedsfruit^{-1} (1.448), fruit firmness (0.604), pericarp thickness (1.785), total soluble solids (0.504), total carotenoids (0.410) and yield hectare^{-1} (1.124). The negative and significant association at genotypic level was registered with weight of 1000 seeds (-0.963), shelf life of fruits (-0.812), titrable acidity (-0.332) and lycopene (-0.926). Fruit weight was positively and significantly correlated with weight of 1000 seeds (0.836), shelf life of fruits (0.675) and lycopene (0.835). The negative and significant association at phenotypic level was registered with weight of seeds fruit^{-1} (-0.296), fruit firmness (-0.449) and yield hectare^{-1} (-0.481). Similar results were also reported by Dhankar *et al.,* (2001), Singh (2005), Mehta and Asati (2008), Senugupta *et al.,* (2009), Kumar and Dudi (2011), Buckseth *et al*., (2012) and Mahapatra *et al*., (2013).

Number of seeds fruit^{-1} exhibited positive and significant relationship with weight of seeds fruit^{-1} (1.629), yield plant^{-1} (0.815), fruit firmness (0.773), pericarp thickness (2.313), shelf life of fruits (0.569), total soluble solids (0.861), ascorbic acid (0.853), titrable acidity (0.514), lycopene (1.558) and yield hectare^{-1} (1.377) while, the negative and significant association at genotypic level was registered in total sugars (-0.946). Number of seeds fruit^{-1} exhibited positive and significant relationship with total sugars (0.887) while, the negative and significant association at phenotypic level was registered in fruit firmness (-0.366) and total soluble solids (-0.366). Weight of seeds fruit^{-1} exhibited positive and significant relationship with weight of 1000 seeds (1.253), shelf life of fruits (1.936), total sugars (0.969), titrable acidity (0.439), lycopene (2.048) and total carotenoids (0.418) whereas, the negative and significant association at genotypic level was registered with fruit firmness (-0.939), pericarp thickness (-1.003), total soluble solids (-0.558)and yield hectare^{-1} (-0.726). Weight of seeds fruit^{-1} exhibited positive and significant relationship with fruit firmness (0.448), pericarp thickness (0.830) and yield hectare^{-1} (0.336) whereas, the negative and significant association at phenotypic level was registered with titrable acidity (-0.427).Weight of 1000 seeds exhibited positive and significant relationship with fruit firmness (0.563), pericarp thickness (1.243), total soluble solids (0.706), total carotenoids (0.586)and yield hectare^{-1} (1.274) while, the negative and significant association at genotypic level was registered with shelf life of fruits (-0.804), titrable acidity (-0.364) and lycopene (-0.949).Weight of 1000 seeds exhibited positive and significant relationship with shelf life of fruits (0.746) and lycopene (0.801) while, the negative and significant association at phenotypic level was registered with yield plant^{-1} (-0.325). These results were in accordance with the reports of Kumar and Dudi (2011), Tasisa *et al.*, (2012) and Mahapatra *et al*., (2013).Yield plant^{-1} was positively and significantly correlated with fruit firmness (0.928), total soluble solids (0.846), total sugars (1.083), total carotenoids (1.321) and yield hectare^{-1} (1.231) whereas, the negative and significant association at genotypic level was registered with shelf life of fruits (-0.472) and titrable acidity (-0.922). Yield plant^{-1} exhibited was positively and significantly correlated with titrable acidity (0.862). There was no negative and significant association at phenotypic level was registered for this trait. The results were in concurrence withfindings of Aravinda kumar and Mulge (2002), Tiwari (2002), Prashanth (2003), Joshi *et al.,* (2004), Lakshmikant and Mani (2004), Mayavel *et al.,* (2005), Raut *et al.* (2005), Ara *et al*., (2009), Kaushik *et al.*, (2011), Buckseth *et al*., (2012), Regassa *et al.*, (2012), Mahapatra *et al*. (2013) and Nadeem *et al.*, (2013).

B. Quality characters

Fruit firmness exhibited positive and significant relationship with shelf life of fruits (0.871), total sugars (0.368), titrable acidity (1.023) and lycopene (0.585) while, the negative and significant association at genotypic level was registered with pericarp thickness (-0.665), total soluble solids (-0.952) and total carotenoids (-0.652). Fruit firmness exhibited positive and significant relationship with total soluble solids (0.904), total carotenoids (0.703) and yield hectare^{-1} (0.906). The negative and significant association at phenotypic level was registered with titrable acidity (-0.451). Similar results were also reported by Joshi *et al.,* (2004), Singh (2005) and Mahapatra *et al*., (2013). Pericarp thickness was positively and significantly correlated withshelf life of fruits (1.780), total sugars (1.139), lycopene (2.774) and total carotenoids (0.661) whereas, the negative and significant association at genotypic level was registered with yield hectare^{-1} (-0.417). Pericarp thickness was positively and significantly correlated with total antioxidant (0.908) whereas, the negative and significant association at phenotypic level was registered with titrable acidity (-0.352). Similar results for correlation of pericarp thickness with these component characters were also cited by Kumar and Dudi (2011), Buckseth *et al*. (2012), Manna and Paul (2012) and Mahapatra *et al*. (2013).Shelf life of fruits exhibited positive and significant relationship with total soluble solids (0.804), total sugars (0.451), total carotenoids (1.210) and yield hectare^{-1} (1.572) while, the negative and significant association at genotypic level was registered with titrable acidity (-0.900) and lycopene (-0.992). Shelf life of fruits exhibited positive and significant relationship with as corbicacid (0.384), titrable acidity (0.459) and lycopene (0.837). There was no negative and significant association at phenotypic level was registered for this trait. Similar results were noted by Indu Rani *et al*. (2010) and Manna and Paul (2012).

Total soluble solids exhibited positive and significant relationship with total sugars (0.353), titrable acidity (0.876) and lycopene (0.543) whereas, the negative and significant association at genotypic level was registered with total carotenoids (-0.818) and yield hectare^{-1} (-1.100). Total soluble solids exhibited positive and significant relationship with total carotenoids (0.807) and yield hectare^{-1} (0.893). Similar results were noted by Indu Rani *et al*., (2010), Buckseth *et al*., (2012), Manna and Paul (2012) and Kumar *et al*., (2013). Total sugars exhibited positive and significant relationship with as corbicacid (0.940), titrable acidity (0.711), lycopene (0.659) and yield hectare^{-1} (0.761). There was no positive or negative and significant association at phenotypic level was registered for total sugars. Similar results were also noted by Kumar and Dudi (2011) for this quality trait. Titrable acidity exhibited positive and significant relationship with total carotenoids (1.185) and yield hectare^{-1} (1.288) whereas, the negative and significant association at genotypic level was registered with lycopene (-0.832). There was no negative and significant association at phenotypic level was registered for titrable acidity. Similar results were noted by Manna and Paul (2012) and Indu Rani *et al*., (2010), Kumar and Dudi (2011) and Manna and Paul (2012).

Lycopene was positively and significantly correlated withyield hectare^{-1} (1.445). There was no positive or negative and significant association at phenotypic level was registered for lycopene. Similar results were also noted by Indu Rani *et al*., (2010) and Kumar and Dudi (2011). Total carotenoids exhibited negative and significant association at genotypic level was registered with yield hectare^{-1} (-0.578). Total carotenoids exhibited positive and significant relationship with yield hectare^{-1} (0.790) whereas, there was no negative and significant association at phenotypic level was registered for this trait. Similar results were also noted by Kumar and Dudi (2011) for this quality trait.

CONCLUSION

The correlation coefficients of the cherry tomato germplasm revealed that the yield hectare^{-1} showed positive and significant association at genotypic level with plant height at flowering, plant height at final harvest, number of primary branches plant^{-1} at flowering, days to first flowering, number of flowering clusters (truss) plant^{-1}, number of fruits cluster^{-1}, number of fruit cluster plant^{-1}, number of fruits plant^{-1}, fruit length, number of locules fruit^{-1}, fruit weight, number of seeds fruit^{-1}, weight of 1000 seeds, yield plant^{-1}, shelf life of fruits, total sugars, titrable acidity and lycopene. The yield hectare^{-1} showed positive and significant association at phenotypic level with number of primary branches plant^{-1} at final harvest, number of flowers cluster^{-1}, fruit width, weight of seeds fruit^{-1}, fruit firmness, total soluble solids and total carotenoids. Hence, these traits may lead to the development of high yielding genotypes of cherry tomato.

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